Mumbai University

Question Paper

[CBSGS – 60:40 PATTERN]

(APRIL – 2014)

PAPER - II

DIGITAL

SIGNALS AND SYSTEMS

Time: 2 ½ Hours **Total Marks:** 60

N.B.: (1) *All Question are Compulsory.*
(2) *Make Suitable Assumptions Wherever Necessary And State The Assumptions Made.*
(3) *Answer To The Same Question Must Be Written Together.*
(4) *Number To The Right Indicates Marks.*
(5) *Draw Neat Labeled Diagrams Wherever Necessary.*
(6) *Use of Non – Programmable Calculator is allowed.*

Q.1 ATTEMPT ANY TWO QUESTIONS: (10 MARKS)

(A) Explain in detail the various types of systems. **(5)**

(B) Check whether the given is Power Signal or Energy Signal and find its value **(5)**

$$x[n] = 3(-1)^n, n \geq 0$$
$$= 0, n < 0$$

(C) Explain in detail with suitable examples the various properties of Fourier Transform. **(5)**

(D) Find the Fourier Transform of the Time Function **(5)**

$$f(t) - 5[u(t+3) + u(t+2) - u(t-2) - u(t-3)]$$

Q.2 ATTEMPT ANY TWO QUESTIONS: (10 MARKS)

(A) Find Inverse Laplace Transform of **(5)**

(i) $F_1(S) = \frac{S^2+5}{S^3+2S^2+4S}$

(ii) $F_2(S) = \frac{3e^{-\frac{S}{3}}}{S^2(S^2+2)}$

(B) A sinusoidal voltage $25 sin\ t$ is applied at the instant $t = 0$ to a series RL Circuit with $R - 5\Omega$ and $L - 1\ H$. Determine $i(t)$ by using Laplace Transform method. **(5)**

(C) The unit step of a network is $(1 - e^{-n})$. Determine the Impulse Response $h(t)$ of the network. **(5)**

(D) Find the Laplace Transform of **(5)**

(i) e^{-t}

(ii) e^{10t}

(iii) $2 - 2e^t + 0.5 \sin 4t$

(iv) $e^{-t} \sin 4t$

(v) $e^{2t} + 2te^{-2t} - t^2$

Q.3 ATTEMPT ANY TWO QUESTIONS: (10 MARKS)

(A) Explain the following properties of z-transform: **(5)**

(i) *Time-reversal*

(ii) *Time Shifting*

(iii) *Time Scaling*

(iv) *Differentiation*

(v) *Convolution*

(B) Determine the causal sequence $x(n)\ for\ X(z)\ given\ by\ X(z) = \frac{1+2z^{-1}}{1-2z^{-1}+4z^{-2}}$ **(5)**

(C) Determine the causal signal having z-transform $X(z) = \frac{z^2+z}{\left(z-\frac{1}{2}\right)^3\left(z-\frac{1}{4}\right)}$ for the region of convergence $|Z| > \frac{1}{2}$ **(5)**

(D) For n low pass RC network, $R - 1\ M\Omega$ and $C - 1\mu l$. Determine the output response for n in the range $C \leq n \leq 3$ when input has a step response of magnitude 2 V and the sampling frequency $f_1 - 50\ Hz$. **(5)**

[TURN OVER]

Q.4 **ATTEMPT ANY TWO QUESTIONS: (10 MARKS)**

(A) Explain the following properties of a Digital Signal Processing System: **(5)**

(i) *Linearity*
(ii) *Time-Invariance*
(iii) *Causality*
(iv) *Stability*
(v) *Bounded Input Bounded Output Stability*

(B) Consider a causal and stable LT! system whose input $x(n)$ and output $y(n)$ are relies through the second order difference equation $y(n) - \frac{1}{12}y(n-1) - \frac{1}{12}y(n-2) = x(n)$ **(5)**

(C) Determine the impulse response for the systems given by the following difference equations: **(5)**

(i) $y(n) + 3y(n-1) + 2y(n-2) = 2x(n) - x(n-1)$
(ii) $y(n) = x(n) + 3x(n-1) - 4x(n-2) + 2x(n-3)$

(D) Compute the response of the system $y(n) = 0.7y(n-1) - 0.12y(n-2) + x(n-1) + x(n-2)$ to the input $x(n) = ny(n)$. **(5)**

Q.5 **ATTEMPT ANY TWO QUESTIONS: (10 MARKS)**

(A) Find the Circular Periodic Convolution using DFT and IDFT of the two sequences: $x(n) = \{1, 1, 2, 2\}$ and $h(n) = \{1, 2, 3, 4\}$ **(5)**

(B) Compute the Circular Periodic Convolution Graphically of the two sequences: $x(n) = \delta(n) + \delta(n-1) - \delta(n-2) - \delta(n-3)$ and $h(n) = \delta(n) - \delta(n-2) + \delta(n-4)$ **(5)**

(C) Given $x(n) = \{1, 2, 3, 4, 5, 6, 7, 8\}$. Find DFT and DIF FFT Algorithm. **(5)**

(D) An FIR Digital Filter has the unit Impulse Response Sequence, $h(n) = \{2, 2, 1\}$. Determine the output sequence in response to the Input Sequence $x(n) = \{3, 0, -2, 0, 2, 1, 0, -2, -1, 0\}$ using the overlap-add convolution Method. **(5)**

Q.6 **ATTEMPT ANY TWO QUESTIONS: (10 MARKS)**

(A) A low pass filter has the desired response as given below **(5)**

$$H_e\left(e^{f\omega}\right) = e^{-f3\omega} 0 \leq \omega \leq \frac{\pi}{2}$$
$$= 0 \; \frac{\pi}{2} \leq \omega \leq \pi$$

Determine the filter coefficient $h(n)$ for $M = 7$, using Type-I frequency sampling technique.

(B) Determine the unit sample response of the Ideal Low Pass Filter? Why is it not realizable? **(5)**

(C) Design a High-Pass Digital FIR filter using Kaiser windows satisfying the specification given below. Passband cut-off frequency, $f_p = 3200 Hz$, stopband cut-off frequency, $f_a = 1600\ Hz$, passband ripple, $A_P - 0.1\ dB$, stopband attenuation, $A_S = 40 dB$ and sampling frequency, $F = 10000\ Hz$. **(5)**

(D) An analog filter has the following system function. Convert this filter into a digital filter using backward difference for the derivative. $H(S) = \frac{1}{(S+0.1)^2+9}$ **(5)**